The Farce of Modern Physics

David Pratt

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Contents

1. Introduction

In the following review of several theories in modern physics, a number of key themes recur.

1. It is essential to distinguish between experimental and observational data on the one hand and the interpretation of those data on the other. Data are often open to more than one interpretation. Any interpretation is based on certain assumptions, which may be unverified or even unverifiable.

2. A model of reality is not the same as reality itself; a map is not the territory. A model or theory is always a simplification, an approximation; it may have a degree of validity and/or utility without being literally true. Even if the equations associated with a particular theory or model allow accurate calculations of real events, this is no guarantee that any particular physical interpretation of those equations corresponds to mechanisms in the real world.

3. Mathematical abstractions – e.g. zero-dimensional particles, one-dimensional strings, two-dimensional spacetime ribbon-tape, and curved spacetime – are not concrete realities. Such concepts may, or may not, be useful in certain contexts, but they have no concrete existence outside the human imagination; they cannot directly influence the material world and *explain nothing*. The inability of many scientists to make this distinction is a root cause of many of the absurd theories, or 'mazes of unrealities', that are passed off as 'science'.[1]

4. In an infinite, eternal universe there can be no ultimate explanations of natural phenomena. But if we want to find the direct causes of events, we have to look to real substances, energies, forces, and entities, whether physical or superphysical. A host of phenomena, and even the very existence of physical matter and force, point to the existence of deeper, subtler levels of reality. As far as physics is concerned, this means thinking in terms of an energetic ether.

Reference

1. See G. de Purucker, *Fundamentals of the Esoteric Philosophy*, Pasadena, CA: Theosophical University Press (TUP), 2nd ed., 1979, p. 476; A.L. Conger (ed.), *The Dialogues of G. de Purucker*, TUP, 1948, 3:324.

2. Flaws in the standard model

By the end of the 19th century, scientists had discovered nearly all 92 naturally occurring chemical elements; each was understood to consist of its own unique kind of atom. The belief that the atom was indivisible was undermined by the discovery of x-rays in 1895 and radioactivity in 1896, and was shattered in 1897 with the discovery of the electron, the first subatomic particle to be identified. This was followed by the discovery of the proton in 1911 and the neutron in 1932, the two particles that are thought to make up the atomic nucleus. In the decades that followed, subatomic particles began to multiply like rabbits. Some were found in the cosmic rays constantly bombarding earth from space, but most were generated in particle accelerators. When particles are smashed together in accelerators, the energies released can give rise to hundreds of transient particles, or 'resonances', that decay into more stable particles after a fraction of a second.

To try and inject some order into this 'particle zoo', the standard model of particle physics was developed.[1] According to the latest version of this model, there are twelve fundamental particles of matter (known as fermions): six leptons (which include the electron) and six quarks. In addition, there is an antimatter particle corresponding to every fundamental matter particle, with the same properties except opposite charge. Since free quarks have proved impossible to detect, it is theorized that they can exist only in composite particles known as hadrons; these are divided into mesons (consisting of quark-antiquark pairs), and baryons (consisting of three quarks), such as the neutron and proton. Since each quark is said to exist in one of three 'colours' (red, blue, or green), the total number of elementary fermions comes to 48.

The 12 basic fermions are grouped into three generations of successively more massive particles. Their masses range from less than 0.00002 electron mass units for the electron neutrino to over 342,000 for the top quark. Note that since individual quarks are undetectable, quark mass is a theoretical construct.

Table 1 Fermions

	Leptons (mass in GeV)		Quarks (mass in GeV)	
Generation 1	Electron 0.000511	Electron neutrino $<1 \times 10^{-8}$	Up 0.003	Down 0.006
Generation 2	Muon 0.106	Muon neutrino <0.0002	Charm 1.3	Strange 0.1
Generation 3	Taon 1.7771	Tau neutrino <0.02	Top 175	Bottom 4.3

Modern physics recognizes four fundamental forces or interactions: gravity, electromagnetism, and the weak and strong nuclear forces. Matter particles are said to carry charges which make them susceptible to these forces. The electron, muon, and taon each carry an electric charge of -1, and participate in electromagnetic interactions. Neutrinos are said to be electrically neutral. The up, charm, and top quarks are said to carry an electric charge of +2/3, while the down, strange, and bottom quarks carry an electric charge of -1/3. The neutron (said to consist of one up-quark and two down-quarks) is electrically neutral, while the proton (said to consist of two 2 up-quarks and one down-quark) carries a charge of +1. The three quark 'colours' are considered to be another, abstract kind of 'charge', which enables quarks to participate in strong nuclear interactions. Both quarks and leptons carry a handful of 'flavour' charges, enabling them to interact via the weak nuclear interaction.

Quantum field theory asserts that each of the four types of force field is quantized. In other words, the electromagnetic, and weak and strong nuclear interactions between matter particles allegedly arise from the exchange of force-carrier particles (known as gauge bosons), which are said to be 'virtual' particles, constantly flickering into and out of existence. 12 bosons are recognized:
• the massless photon mediates the electromagnetic force;
• the W^+, W^- and Z^0 bosons mediate weak nuclear interactions, causing certain decay processes; they have masses of 80.4 and 91.2 GeV (billion electron-volts), and a mean life of about 3×10^{-25} seconds;
• eight massless gluons mediate strong nuclear interactions between quarks.

Fermions and bosons are assigned an angular-momentum property known as 'spin'. Fermions are said to have half-integer spin; all known elementary particles have spin-1/2. Bosons are said to have integer spin; all the bosons mentioned above have spin-1. This is interpreted to mean that they do not obey the Pauli exclusion principle, meaning that more than one can exist in the same place at the same time, producing a stronger force.

The standard model does not include an explanation of gravity, which most scientists believe is best described by general relativity theory. This theory claims that gravity is not a force that propagates across space but results from masses distorting the 'fabric of spacetime' in their vicinity in some mysterious way. Since 'curved spacetime' is a geometrical abstraction, relativity theory is merely a mathematical model and does not provide a realistic understanding of gravity. There are alternative, more rational explanations for all the experiments cited in support of special and general relativity.[2] Quantum gravity theories, which go beyond the standard model, postulate that gravity is mediated by a massless, spin-2 graviton.

Table 2 Fundamental forces

Force	Relative strength*	Range
Gravity	1	infinite – attractive
Electromagnetism	10^{36}	infinite – attractive, repulsive
Weak nuclear	10^{25}	10^{-18} m – neither attractive nor repulsive
Strong nuclear	10^{38}	10^{-15} m – attractive, repulsive
*Approximate; the exact strengths depend on the particles and energies involved.		

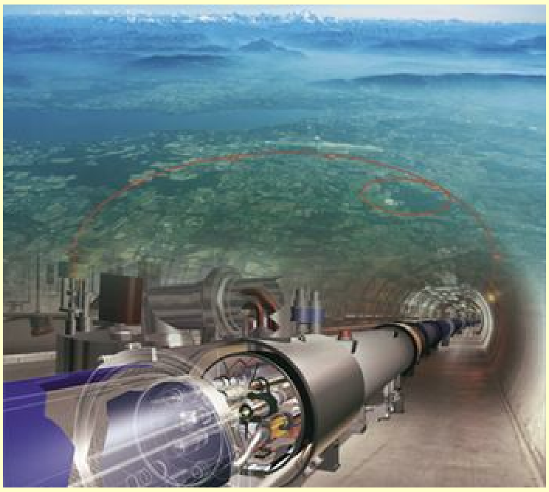

Fig. 2.1 The Large Hadron Collider at CERN, Geneva. Completed in 2008, it is 27 km long and cost over $6bn to build. (www.sar-hessen.org)

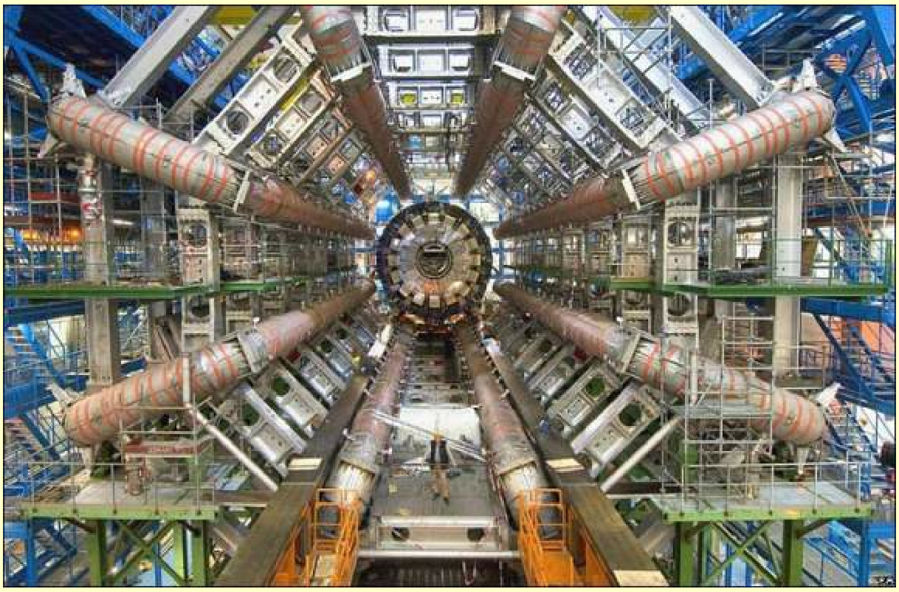

Fig. 2.2 The ATLAS particle detector at the Large Hadron Collider. (davidarling.info)

The standard model predicts another elementary particle, known as the Higgs boson, bringing the total number of elementary fermions and bosons to 61. Sometimes dubbed the 'god particle', the Higgs boson is said to be a component of the hypothetical Higgs field; elementary particles supposedly acquire mass by interacting with this field – including the Higgs particle of which the Higgs field consists! This is said to occur through spontaneous symmetry-breaking of the SU(2) gauge symmetry – one of the abstract mathematical symmetries theorists have dreamt up to classify and 'understand' fundamental particles. The Higgs particle is said to have no spin, electric charge, or colour charge, and to be so unstable that it decays into other particles almost immediately. Some extensions of the standard model predict the existence of more than one kind of Higgs boson. In July 2012, the CMS and the ATLAS experimental teams at the Large Hadron Collider announced that they had each detected a spike in their data which they interpreted to be a very heavy particle with a mass of 125.3 and 126.5 GeV respectively. It is said to be 'consistent with' the Higgs boson, though there are also certain discrepancies with predictions.[3] An analysis published in 2014 concluded that, while a new particle may have been found, there is no conclusive evidence that it is the Higgs particle.[4]

Problems

Plasma physicist Eric Lerner says that although the standard model makes valid predictions within broad limits of accuracy,

> it has no practical application beyond justifying the construction of ever-larger particle accelerators. Just as electromagnetism and quantum theory successfully predict the properties of atoms, one might expect a useful theory of the nuclear force to predict at least *some* properties of nuclei. But it can't. Nuclear physics has split with particle physics; nuclear properties are interpreted strictly in terms of empirical regularities found by studying the nuclei themselves ...[5]

One of the unsatisfactory features of the standard model in the eyes of physicists is that a total of 29 constants, including all particle masses and the strengths of the interactions, have to be plugged into the theory by hand, based on observation.

A major shortcoming of the standard model is that leptons and quarks are pictured as structureless, zero-dimensional, infinitely small particles. But infinitesimal points are abstractions, not concrete realities with measurable properties. If the electron were infinitely small, the electromagnetic force surrounding it would have an infinitely high energy, since electrical force increases as distance decreases; the electron would therefore have an infinite mass. This is nonsense, for an electron has a mass of 9.1 x 10^{-28} grams, or 511 keV (thousand electron-volts). To get round this embarrassing situation, physicists use a mathematical trick: they simply divide each positive infinity by a negative infinity and then substitute the experimentally known values. This dubious procedure – known as 'renormalization' – was pioneered by Richard Feynman, Julian Schwinger, and Sin-Itiro Tomanaga, who were awarded the 1965 Nobel Prize in physics for their efforts. Feynman admitted that renormalization was 'hocus pocus', and that they had merely 'swept the infinities under the rug'.[6]

Unlike mass and electric charge, many of the other properties that particles are assigned have no realistic, physical meaning. 'Colour charge', for example, is a purely abstract 'property'. And quantum 'spin' does not refer to the classical concept of spin; spin-½ electrons, for example, supposedly have to be rotated through 360° twice in order to return to their original position. Theoreticians also invented the notion of 'isospin': it is claimed that if a nucleon (a particle composing an atomic nucleus) is 'spun' one way it becomes a proton, and if 'spun' the other way it becomes a neutron. But such 'spinning' takes place not in the space we move in, but in an imaginary mathematical realm.

Despite sensational claims of finding all six types of quarks predicted by modern theory, single quarks have never been directly observed, and their existence is inferred from the correspondence of their expected properties with the light, heat and path generated by a violent collision in a particle accelerator. Note that accelerator experiments produce more data than could ever be interpreted, so supercomputers sift through this information looking for the patterns that theorists have decided are important.

In some particle collisions, concentrated jets of particles are emitted in certain directions, and this was interpreted to mean that unobserved quarks are being hit which then emit observable particles in the direction in which they are moving. However, quark theory has made few if any predictions that were subsequently verified and has been continually modified to accommodate new observations. When Murray Gell-Mann first proposed the theory in 1964, there were only three quarks (and three antiquarks). That number has since

risen to 36, plus 8 gluons, and not a single one of these supposedly physical particles has ever been directly observed. Each quark is theorized to carry an electric charge measuring either one-third or two-thirds of an electron charge, but no such charges have ever been detected.

Quark theory predicts that protons should interact approximately 25% more frequently if their spins are aligned in the same direction (parallel) than if they are oppositely aligned (antiparallel). But instead, colliding protons interact up to five times more frequently if their spins are parallel aligned – over an order of magnitude greater than predicted. What's more, they also deflect nearly three times more frequently to the left than to the right. These experiments imply that the spin is carried by the proton itself, not by hypothetical quarks. Lerner suggests that protons are better modelled as some form of vortex. Plasma vortices (plasmoids), for example, interact far more strongly when they are spinning in the same direction.[7]

The standard model claims that matter particles were originally massless, even though mass is surely an intrinsic property of matter. To explain mass, it invokes a hypothetical *massive* particle – the spin-0 Higgs boson. This particle was needed to make electroweak theory renormalizable. One scientist explained that the Higgs field is like 'cosmic mud', and that some of the 'mud' sticks to a particle travelling through it, thereby giving it mass. A particle with mass exhibits the unexplained property of inertia, meaning that it tends to resist acceleration. Most scientists assume, without any compelling evidence, that accelerated particles radiate energy. Harold Aspden, by contrast, argues that accelerated particles try to *conserve* their energy – thereby giving rise to inertia.[8]

The virtual particles (bosons) invoked to account for the four fundamental forces lack any experimental support. The particles emitting or being struck by them would experience a mutually repulsive force, and there is no explanation of how boson impacts could produce an attractive force. Strictly speaking, since force-carrier particles, like fundamental matter particles, are regarded as infinitely small, zero-dimensional point particles, they are no more than mathematical fictions and are therefore incapable of imparting any force at all.

The standard model predicted the masses of the W and Z bosons at energies of about 80 or 90 GeV before these particles were observed in 1983. However, this does not mean that the electroweak theory (which 'unifies' electromagnetism and the weak force) is correct. Energy events have been measured in particle accelerators that match the predicted particles, but Harold Aspden's model of ether physics can explain these events in terms of a far simpler and more intelligible model of what is happening at the subquantum level; the energy thresholds at which short-lived particles are created are determined by the ether structure. Aspden dismisses electroweak theory as 'a jungle of nonsense' cloaked in multiple layers of equations.[9] His own model provides a far more accurate estimate of the mass of a muon than does electroweak theory.[10]

The weak nuclear force is a very curious type of 'force'. Many orders of magnitude weaker than the electromagnetic force, it is responsible for radioactivity and hydrogen fusion, and supposedly converts neutrons into protons by tampering with quarks. The strong nuclear force between neutrons and protons is also very peculiar. Up to a distance of around 10^{-15} m (1 fermi), it is very strongly repulsive, keeping nucleons apart. Then, for unknown reasons, it abruptly becomes very strongly attractive, before dropping off very rapidly. Current theory claims that this somehow results from the inter-quark gluon force 'leaking' out of the nucleon. Obviously if quarks don't exist no force is required to hold them together. As for the force holding protons and neutrons together, some alternative theories argue that there are *no* neutrons in the atomic nucleus, only positive and negative charges held together by ordinary electrostatic forces.[11]

There are serious problems with the theory that 'virtual' particles are continually appearing from nowhere and then disappearing so fast as to be unobservable. Each such event violates the law of the conservation of energy, but physicists turn a blind eye to this as it lasts only for a fraction of second, which is allegedly allowed by the Heisenberg 'uncertainty principle'. However, at any given moment there are unlimited numbers of such particles, so no matter how briefly each one exists, this amounts to a permanent loan of infinite energy. Moreover, according to general relativity theory, all this energy should curve the universe into a little ball – which obviously doesn't happen. Experiment confirms that detectable electron-positron pairs surround every charged particle. Quantum theory does not explain where they come from or go to; the equations simply contain a 'creation operator' and an 'annihilation operator'. Realistically, since nothing comes from nothing, there must be a subquantum energy realm not included in standard physics, out of which physical particles crystallize and back into which they can dissolve. Richard Feynman invented the notion that a positron (anti-electron) was really an electron travelling backwards in time. It is amazing that such twaddle is taken seriously, while any talk of an etheric medium is dismissed.

Another controversial issue is the status of the neutrino. Neutrinos are said to be chargeless and to pass through ordinary matter almost undisturbed at virtually the speed of light, making them extremely difficult to detect. They come in three types or flavours, and are said to be created by certain types of radioactive decay, by nuclear reactions such as those in nuclear reactors or those alleged to occur in stars, or by the bombardment of atoms by cosmic rays. Most neutrinos passing through the earth are said to come from the sun; more than 50 trillion solar electron neutrinos allegedly pass through the human body every second, and it would take approximately one light-year of lead to block half of them. For decades detectors have only observed about a third of the predicted number of solar neutrinos. This problem was 'solved' by assuming that neutrinos have a minuscule mass, and can change flavour; for some reason, two-thirds of electron neutrinos emitted by the sun change into muon or tau neutrinos, which go undetected.

The neutrino was first postulated in 1930 when it was found that, from the standpoint of relativity theory, beta decay (the decay of a neutron into a proton and an electron) seemed to violate the conservation of energy. Wolfgang Pauli saved the day by inventing the neutrino, a particle that would be emitted along with every electron and carry away energy and momentum (the emitted particle is nowadays said to be an antineutrino). W.A. Scott Murray described this as 'an implausible ad hoc suggestion designed to make the experimental facts agree with the theory and not far removed from a confidence trick'.[12] Aspden calls the neutrino 'a figment of the imagination invented in order to make the books balance' and says that it simply denotes 'the capacity of the aether to absorb energy and momentum'.[13] Several other scientists have also questioned whether neutrinos really exist.[14]

Fig. 2.3 The dome of the world's largest underground neutrino observatory – the Super-Kamiokande in Japan. Situated 2700 m below ground, it consists of a tank 42 m high and 39 m in diameter, containing 32,000 tons of ultra-pure water, viewed by some 13,000 sensitive photomultiplier tubes. It cost about $100 million to build. (http://neutrino.phys.washington.edu)

Like particle-accelerator experiments, neutrino detection has developed into a huge industry, and several Nobel Prizes have been awarded to scientists working in that field. However, what such experiments actually detect is not neutrinos themselves, but either the effects of neutrinos on the energy and momentum of a target particle, or the particles into which neutrinos are believed to have changed. Cosmic rays, gamma rays, and neutral particles such as the pion, kaon, or neutron can mimic the desired neutrino signals, and it is questionable whether the experiments concerned have been properly shielded against them. The detection of neutrinos from the 1987 supernova is often cited as compelling evidence that neutrinos exist. But if genuine neutrinos were detected from that supernova, we ought to detect thousands of neutrino events from the sun every day, whereas only a few dozen are observed.[15] The unrepeatable results obtained by neutrino detection experiments, the dubious data manipulation practices, and the frequent failure to publish all the raw data have come in for strong criticism.[16]

The electron and proton are both stable particles, the proton being 1836 times more massive than the electron. Their antiparticles (the positron and antiproton) are also stable. These four particles are arguably the only four stable particles that are of any importance. As regards neutrons, they have never been directly observed within the atomic nucleus, but because they sometimes appear as a decay product, it is assumed that they exist there. It is further assumed that within the nucleus they are stable, whereas outside the nucleus they are observed to decay into a proton and electron (and an 'antineutrino') in about 15 minutes. Quark theory has no explanation for this. Moreover, it is illogical to suppose that a neutron decays into a proton and electron, given that both the neutron and proton are supposed to consist of three quarks, while the electron is said to be an elementary particle containing no quarks.

The decay of a neutron into a proton and electron led to the original hypothesis that a neutron is in fact a bound state of one proton and one electron. This hypothesis was subsequently abandoned because it seemed unable to explain certain neutron properties, though some scientists have argued that these difficulties can be overcome.[17] Aspden contends that an atomic nucleus might shed protons and negative beta particles (electrons) in a highly energetic paired relationship, which has been mistaken for an unstable 'neutron'. He also contends that, besides etheric charges, atomic nuclei contain only protons, antiprotons, electrons, and positrons. The 'neutron' might really be an antiproton enveloped by a lepton field, including a positron – a theory which can account for the precise lifetime, mass, and magnetic moment of the neutron.[18]

In conclusion, there is a distinct possibility that most of the standard model of particle physics will eventually be discarded.

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3. Symmetry delusions and unification

For most physicists, unification means symmetry. At higher and higher energies, matter and force particles begin to merge together, resulting in more and more symmetry. Perfect symmetry supposedly existed just after the big bang, the mythical event when all existence – all matter and energy, and even space and time – exploded into being out of nothing. This age of perfect symmetry is believed to have lasted for just ten million-trillion-trillion-trillionths of a second (10^{-43} s), during which time space supposedly expanded a trillion trillion trillion trillion (10^{48}) times faster than light, an event labelled ‘inflation’. As the universe cooled, spontaneous symmetry-breaking occurred. First gravity separated out as a distinct force, then the strong nuclear force, and finally the weak nuclear force and electromagnetism. The original high-energy particles allegedly formed a sort of quark-gluon plasma, from which the particles we know today eventually emerged and began to combine.

Each year roughly $775 million is spent on high-energy physics in the US, and a similar amount in Europe. The aim is to build ever bigger and more powerful particle accelerators in order to recreate the more unified and symmetrical state of affairs that supposedly existed just after the big bang. This could be called the sledgehammer approach to unification: smash things together violently enough and they’ll merge into one. There is little doubt that an unlimited number of further short-lived ‘resonances’ will be found as the velocity of particle collisions is increased. But there is no reason to think that they have any great relevance to understanding the structure of the material world. There is not a single realistic mainstream theory of what electrons and protons (and their antiparticles) actually are, and scientists are unlikely to become any wiser by studying the debris produced by smashing these particles together at ultra-high energies.

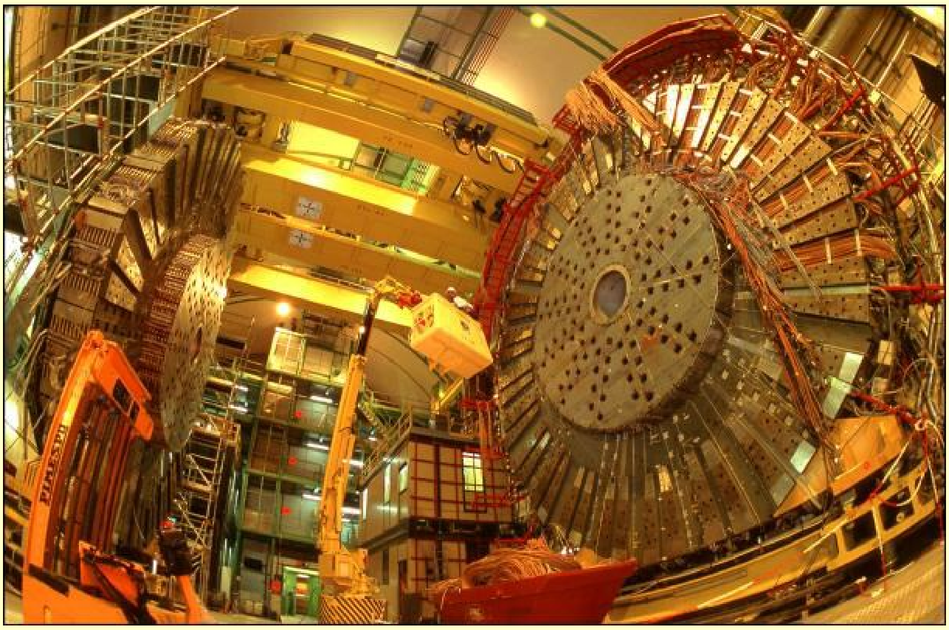

Fig. 3.1 The DELPHI detector at the Large Electron Positron collider (LEP), CERN. (http://home.fnal.gov/~skands)

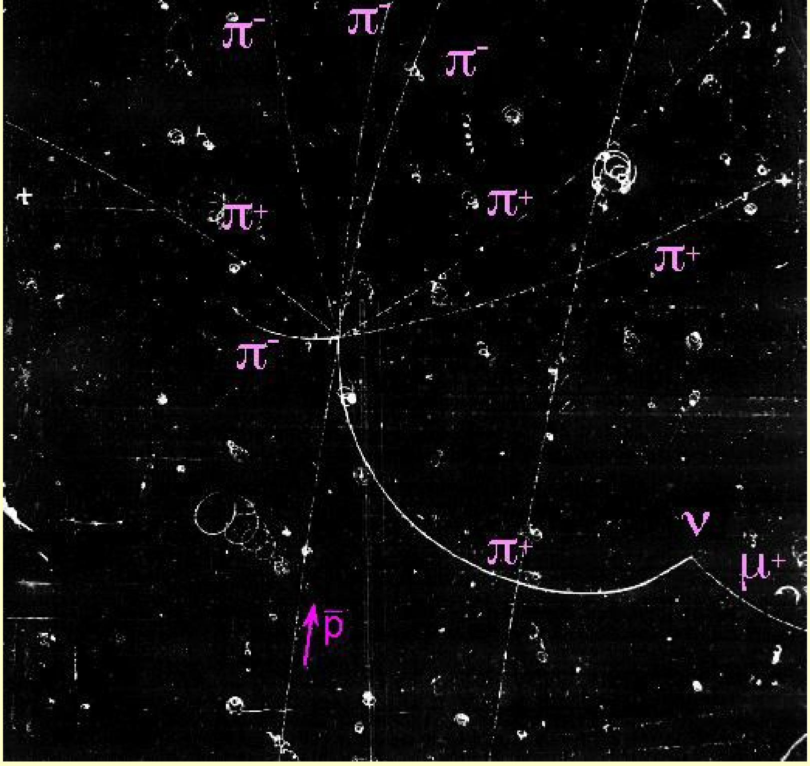

Fig. 3.2 Particle tracks (trails of tiny bubbles) in an old-style bubble chamber. An antiproton enters from the bottom, collides with a proton (at rest), and 'annihilates', giving rise to eight pions. (http://particleadventure.org)

The road to unification began in the 19th century. A unified understanding of electricity and magnetism was supposedly achieved by James Clerk Maxwell, who published his equations on the subject in 1864. Although this is what the textbooks assert, many scientists have shown that Maxwell's equations do not provide a proper understanding of electric and magnetic forces. James Wesley writes: 'the Maxwell theory fails many experimental tests and has only a limited range of validity ... The fanatical belief in the validity of Maxwell's theory for all situations, like the fanatical belief in "special relativity", which is purported to be confirmed by the Maxwell theory, continues to hamper the progress in *physics*.'[1] Pioneering scientists and inventors Paulo and Alexandra Correa show that Maxwell's fundamental errors included the wrong dimensional units for magnetic and electric fields and for current – 'two epochal errors now reproduced for over a century, and which have done much to *arrest the development of field theory*'.[2]

According to Newton's third law, every action causes an equal and opposite reaction. But out-of-balance electrodynamic forces have been observed in various experimental settings, e.g. anomalous cathode reaction forces in electric discharge tubes, and anomalous acceleration of ions by electrons in plasmas. To explain this, some scientists argue that the modern relativistic Lorentz force law should be replaced by the older Ampère force law.[3] But this law, too, is inadequate. Both Lorentz and Ampère assumed that interacting electrical circuits cannot exchange energy with the local 'vacuum' medium (i.e. the ether). In 1969 Harold Aspden published an alternative law of electrodynamics, which can explain all the experimental evidence: it modifies Maxwell's third law of electrodynamics to take account of the different masses of the charge carriers involved (e.g. ions and electrons), and allows energy to be transferred to and from the surrounding ether. Action and reaction only balance, says Aspden, if the ether is taken into account.[4] An additional problem is that Lorentz assumed that the field force propagates at the speed of light, while Ampère assumed instantaneous action at a distance. Clearly, to retain causality, forces must propagate at finite speeds, but the Correas argue that the field force, which is carried by *etheric* charges, is not restricted to the speed of light, and should not be confused with the mechanical force that two *material* charges exert on one another.[5]

The correctness of Aspden's law is demonstrated by the Pulsed Abnormal Glow Discharge (PAGD) reactors developed by the Correas, which produce more power than is required to run them by exciting self-sustaining oscillations in a plasma discharge in a vacuum tube. With an overall performance efficiency of 483%, the devices are clearly drawing energy from a source that does not exist for official physics; Aspden identifies the mechanism involved as 'ether spin'.[6] The US Patent Office granted three patents for the PAGD invention in 1995/96, thereby confirming that the 'impossible' – over-unity power generation – is in fact possible.

However, mainstream theoretical physicists are too busy theorizing to pay any attention to verifiable experimental facts and technological discoveries that upset classical electromagnetic theory. As Wilhelm Reich put it, 'they have abandoned reality to withdraw into an ivory tower of mathematical symbols'.[7] Believing that electricity and magnetism had been adequately unified, they blindly went ahead with the next step in 'unification': by invoking abstract symmetries (gauge theory), the electromagnetic and weak nuclear forces were supposedly shown in the 1970s to be facets of a common 'electroweak' force. As already mentioned, some nonmainstream researchers dismiss electroweak theory as idle mathematical speculation.

The next move was to try and unify the electroweak and strong forces into a 'grand unified force'. According to Grand Unified Theories, or GUTs, the fusion of these two forces takes place at energies above 10^{14} GeV. The corresponding force-carrier particles are known as X and Y bosons, but they have not been observed as their theoretical energies are far beyond the reach of any accelerator.

One testable prediction of GUTs is the slow decay of protons into pions and positrons. Without proton decay the big bang theory collapses, because all the matter and antimatter created in the first instants of time would annihilate each other and there would be no excess of protons and electrons left over to form the observable universe. The GUTs predicted that protons should have an average life of 10^{30} years. However, experiments failed to find any sign of proton decay. So GUT theorists went back to their blackboards, tweaked their equations, and proved that the lifetime of protons was about 10^{33} years – far too long to be disproved by experiments.

GUT models predicted the existence of extremely massive particles known as magnetic monopoles or ‘hedgehogs’ (all *known* magnets are dipoles, i.e. have north and south poles). None have been detected, but it has been claimed that if they did exist they would have been inflated out of existence by the supposed expansion of the universe. GUTs also predicted topological defects in ‘spacetime’, such as one-dimensional cosmic strings and two-dimensional domain walls. Not surprisingly, these abstract mathematical constructs have never been observed.

In order to include gravity and produce a fully unified theory of a ‘superforce’, theorists are seeking a quantum description of gravity. As mentioned in the previous section, modelling an electron as a point particle means that the energy of the virtual photons surrounding it is infinite and the electron has an infinite mass – an embarrassment that is overcome by applying the mathematical trick of renormalization. While photons react strongly with charged particles but do not couple with each other, gravitons are believed to couple extremely feebly with matter particles but to interact strongly with each other. This means that each matter particle is surrounded by an infinitely complex web of graviton loops, with each level of looping adding a new infinity to the calculation.[8] This made it necessary to divide both sides of the equation by infinity an infinite number of times.

Meanwhile, symmetry had been superseded by supersymmetry (or SUSY), which is rooted in the concept of spin. The basic idea is that matter particles (fermions) and force-carrier particles (bosons) are not really two different kinds of particles, but one. Each elementary fermion is assumed to have a boson superpartner with identical properties except for mass and spin. For each quark there is a squark, for each lepton a slepton, for each gluon a gluino, for each photon a photino, etc. In addition, for the bosonic Higgs field it is necessary to postulate a second set of Higgs fields with a second set of superpartners.

A major problem is that these new particles (known as ‘sparticles’) cannot have the same masses as the particles already known, otherwise they would have already been observed; they must be so heavy that they could not have been produced by current accelerators. This means that supersymmetry must be a spontaneously broken symmetry, and this is said to be a disaster for the supersymmetric project as it would require a vast array of new particles and forces on top of the new ones that come from supersymmetry itself. This completely destroys the ability of the theory to predict anything. The end result is that the model has at least 105 extra undetermined parameters that were not in the standard model.[9]

Supersymmetry required the graviton to be accompanied by several types of gravity-carrying particles called gravitinos, each with spin-3/2. It was thought that these might somehow manage to cancel out positive infinities from graviton loops. But the infinity cancellations were found to fail when many loops were involved.[10]

Theorists seeking a geometrical explanation for *all* the forces of nature, rather than gravity alone, found that at least 10 dimensions of space and one of time were required, making 11 in all. The fact that the most economical description of ‘supergravity’ (the combined effect of gravitons and gravitinos) – called N = 8 – also required 11 dimensions gave the theory a boost. In 1980 Stephen Hawking declared that there was a 50-50 chance of a ‘theory of everything’ being achieved by the year 2000, and N = 8 was his candidate for such a theory. But within just four years this theory had gone out of fashion.[11] As well as being plagued with infinities, it required space and time together to possess an even number of dimensions to accommodate spinning particles, but 11 – even for advanced mathematicians – is an *odd* number.[12]

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4. Strings and branes: mathematical fantasies

The next fad was string theory, which postulates that the fundamental building blocks of all particles and fields, and even space (and time!) are one-dimensional 'strings'. These hypothetical objects are said to average a billion-trillion-trillionth of a centimetre (10^{-33} cm) in length but to have no breadth or thickness. Strings allegedly exist in 10 dimensions of spacetime (or 26 according to an earlier version of the theory), but the reason we see only three dimensions of space is because the others have conveniently shrivelled out of sight (or 'compactified') so that they are unobservable. Strings – or 'superstrings', if supersymmetry is included – can stretch, contract, wiggle, vibrate, and collide, they can be open or closed (like loops), and their various modes of vibration are said to correspond to the various kinds of particles. A property such as charge supposedly results from motion in the additional compact dimensions (known as Calabi-Yau spaces).

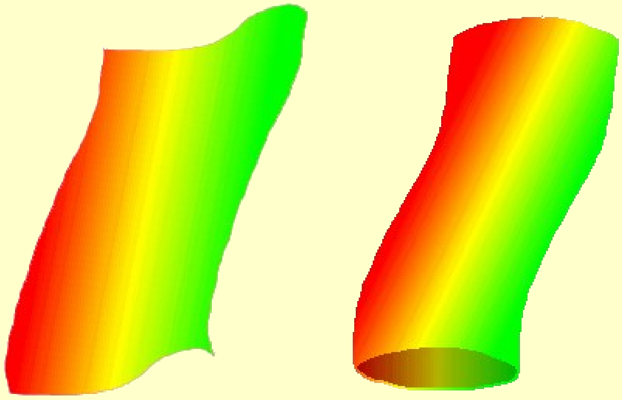


Fig. 4.1 Strings supposedly have length but no breadth or thickness. A one-dimensional entity is a pure abstraction, and would obviously not look anything like the objects shown in this diagram. (www.ft.uam.es)

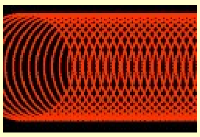


Fig. 4.2 As you can see in this animation, compactifying an extra dimension is really very easy! (http://mysite.wanadoo-members.co.uk)

Replacing zero-dimensional point particles with one-dimensional, infinitely thin strings and conjuring up six extra 'compactified' dimensions of space is hardly much of an advance towards a realistic model. Yet superstring theory is widely regarded as one of the most promising candidate theories of quantum gravity, which aims to harmonize general relativity theory (which focuses on continuous fields) with quantum mechanics (which focuses on discrete quanta). However, string theory has no experimental support whatsoever; to detect individual strings would require a particle accelerator at least as big as our galaxy. Moreover, the mathematics of string theory is so complex that no one knows the exact equations, and even the approximate equations are so complicated that so far they have only been partially solved.[1]

Physicist Peter Woit writes: 'More than twenty years of intensive research by thousands of the best scientists in the world producing tens of thousands of scientific papers has not led to a single testable experimental prediction of superstring theory.'[2] This is because superstring theory 'refers not to a well-defined theory, but to unrealised hopes that one might exist. As a result, this is a "theory" that makes no predictions, not even wrong ones, and this very lack of falsifiability is what has allowed the whole subject to survive and flourish.' He accuses string theorists of 'groupthink' and 'an unwillingness to evaluate honestly the arguments for and against string theory'.[3]

In 1995 superstring guru Edward Witten sparked the 'second superstring theory revolution' by proposing that the five variants of string theory, together with 11-dimensional supergravity, were part of a deeper theory, which he dubbed M-theory. This theory (sometimes called 'the theory formerly known as strings') postulates a universe of 11 dimensions, inhabited not only by one-dimensional strings but also by higher-dimensional 'branes': two-dimensional membranes, three-dimensional blobs (three-branes), and also higher-dimensional entities, up to and including nine dimensions (nine-branes). It is speculated that the fundamental components of 'spacetime' may be zero-branes (i.e. infinitesimal points).[4]

No one is sure what the 'M' in M-theory stands for. Supporters suggest: membrane, matrix, master, mother, mystery, or magic. Others suggest it is an upside-down 'W', for 'Witten'. Critics have proposed that the 'M' stands for: missing, murky, moronic, or mud. Another suggestion is 'masturbation', in line with Gell-Mann's likening of mathematics to mental masturbation. In any event, as Lee Smolin says, M-theory 'is not really a theory – it is a conjecture about a theory we would love to believe in'.[5]

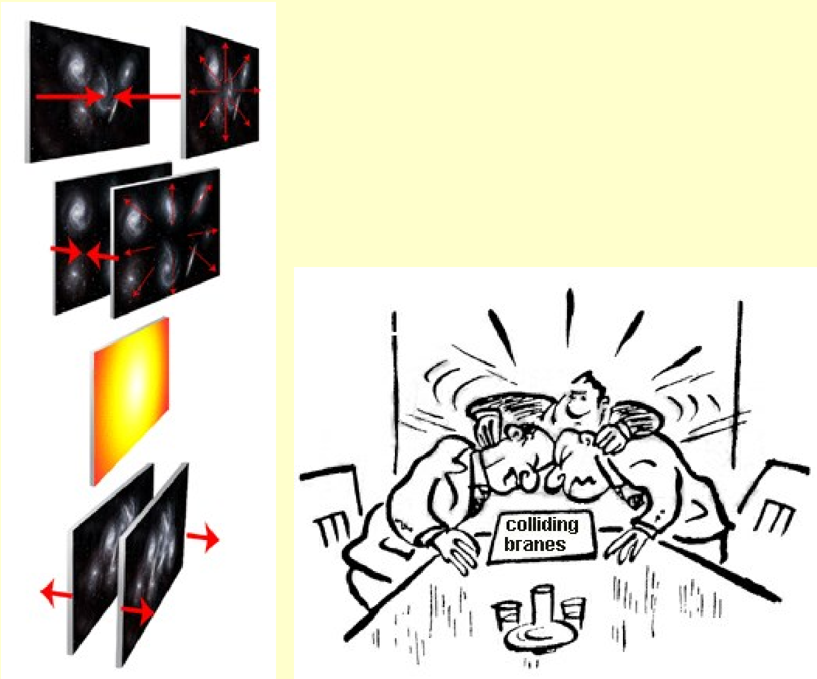
Many brane theorists believe that our world is a three-dimensional surface or brane embedded in a higher-dimensional space, called the 'bulk'. In some models other branes are moving through the bulk and may interact with our own. To explain the relative weakness of

the gravitational force, theorists proposed that all four forces were confined to our own brane but that gravity was 'leaking' into the bulk by some unknown mechanism. In 1999 came another proposal: that gravity resides on a different brane than ours, separated from us by a five-dimensional spacetime in which the extra dimension is either 10^{-31} cm wide or perhaps infinite. In this model,

> all forces and particles stick to our three-brane except gravity, which is concentrated on the other brane and is free to travel between them across spacetime, which is warped in a negative fashion called anti-De Sitter space. By the time it gets to us, gravity is weak; in the other brane it is strong, on a par with the three other forces.

The two scientists who originated this now widely discussed model said they had been 'dead scared' because 'there was a distinct fear of making complete fools of ourselves'.[6] It's hard to see why they were so worried: their absurd speculations are no dafter than the rest of the brainless buffoonery that passes for brane theory.

String theory and M-theory, like standard particle physics, are wedded to the prevailing cosmological myths of the big bang and expanding space. The reigning theory is that at the moment of the big bang the entire universe – including space itself – exploded into being out of nowhere in a random quantum fluctuation. Before it started to expand, it measured just 10^{-33} cm across, and had infinite temperature and density. The main piece of evidence for this fairytale is that 'space is expanding'. But no one has ever directly measured any expansion of space. The standard view is that space does not in fact expand within our own solar system or galaxy or within our local group of galaxies or even our own cluster of galaxies; instead, it only expands *between* clusters of galaxies – where, conveniently, there is no earthly chance of making any direct observations to confirm or refute it. Since space is surely infinite, how can it get any bigger? Expanding space is simply a far-fetched interpretation of the fact that light from distant galaxies displays a spectral redshift. A far more sensible interpretation of the redshift is that light loses energy as it travels through the ether of space.[7] More recently, cosmologists have 'deduced' that the (imaginary) expansion of space is accelerating, and have invented 'dark energy' – which somehow produces a small repulsive force, or 'cosmological constant' – to 'explain' this.



> **Fig. 4.3** *Left:* Our universe was supposedly created by the collision of two branes and, after expanding and dying out, it will be recreated by another brane collision (http://draconem.vox.com). *Right:* A more desirable form of 'brane' collision: two brane-theorists having their heads knocked together in an effort to make them see sense.

An alternative big bang model – known as the cyclic universe – was put forward by Paul Steinhardt and Neil Turok in 2001. They start from the view that our three-dimensional world or brane is embedded in a space with an extra spatial dimension, and is separated by a microscopic distance from a second similar brane. A weak, spring-like force (dark energy) holds the two branes together and causes them to smash into one another and bounce apart at regular intervals. At present, the two branes are moving apart, causing space to expand. After a trillion years or so, the fifth dimension will begin to contract, and space will cease to expand, but will not contract. The latest idea is that the two branes will never actually collide but, as they get closer, they will repel each other, initiating a new big bang. Steinhardt claims that 'unproven and exotic notions' like extra dimensions and branes are helping to make the idea of a cyclic universe 'more comprehensible, and perhaps even compelling as a model for our universe'.[8] However, given that the model makes the *elementary error* of treating mathematical abstractions as concrete realties, it is merely yet another example of the arbitrary nonsense that can be dreamt up once the mathematical imagination is given free rein.

Peter Woit says that superstring theorists can be very arrogant and 'often seem to be of the opinion that only real geniuses are able to work on the theory, and that anyone who criticises such work is most likely just too stupid and ignorant to understand it'. A rather excitable superstring enthusiast, a Harvard faculty member, has said that those who criticize the funding of superstring theory are 'terrorists' and deserve to be eliminated by the US military.[9] Paul Dirac once said that 'It is more important to have beauty in one's equations than to have them fit experiment'.[10] Some physicists argue that the mathematics of string theory and M-theory is so beautiful that it cannot possibly be wrong. But Woit says that these theories are 'neither beautiful nor elegant':

> The ten- and eleven-dimensional supersymmetric theories actually used are very complicated to write down precisely. The six- or seven-dimensional compactifications of these theories necessary to try to make them look like the real world are

both exceedingly complex and exceedingly ugly.[11]

Richard Feynman bluntly dismissed string theory as 'nonsense'.[12] And another Nobel laureate, Sheldon Glashow, once commented: 'Contemplation of superstrings may evolve into an activity ... to be conducted at schools of divinity by future equivalents of medieval theologians. ... For the first time since the dark ages we can see how our noble search may end with faith replacing science once again.'[13] String enthusiast Michio Kaku has described the basic insight of string theory as 'The mind of God is music resonating through 11-dimensional hyperspace.' Woit comments: 'Some physicists have joked that, at least in the United States, string theory may be able to survive by applying to the federal government for funding as a "faith-based initiative".'[14] Increasingly vocal critics within the physics community accuse M-theorists, brane-worldists, and string cosmologists of dealing in mathematics rather than physics. Harvard physicist Howard Georgi characterized modern theoretical physics as 'recreational mathematical theology'.[15]

In an effort to simplify the standard model of particle physics, some physicists in the late 1970s proposed that quarks and leptons might consist of subcomponents, named 'preons' (also known as prequarks or subquarks); they were regarded as point particles, and according to one model only two kinds were needed. However theorists were unable to formulate a model which could account for both the small size and light weight of observed particles. More recently, more exotic preon models have been developed, which propose that bosons, too, are composed of preons. One model proposes that preons are two-dimensional 'braided ribbons', 'braids of spacetime', or 'pieces of spacetime ribbon-tape'. This model can be linked to M-theory, but also to an alternative theory known as loop quantum gravity, which preserves many features of general relativity, but pictures 'spacetime' as quantized, i.e. as consisting of 'discrete chunks'. One of its alleged advantages is that, unlike string theory, it is 'background-independent', meaning that it does not assume any fixed geometry and properties of space and time; the number of spatial dimensions could allegedly change from one moment to the next.[16]

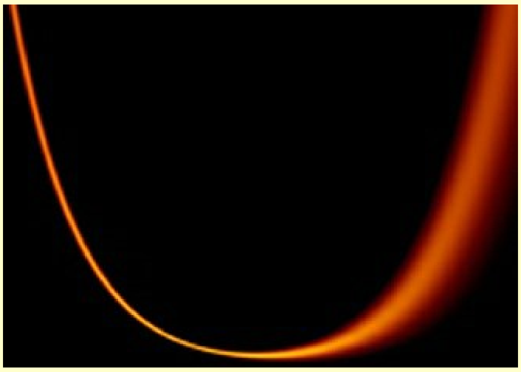


Fig. 4.4 This diagram represents a 'bigbounce'. According to loop quantum gravity, the universe expands, crunches, and bounces from one classical region of spacetime to another via a quantum bridge (http://draconem.vox.com). It sounds like another very promising concept – for science fiction writers!

Whatever the ultimate fate of string theory and M-theory, the modern scientific obsession with abstract topologies, geometries, symmetries, and extra dimensions looks set to continue for some time to come. But there is no evidence that the dimensions invented by modern scientists are anything other than mathematical fictions. The standpoint expressed by H.P. Blavatsky therefore still holds: 'popular common sense justly rebels against the idea that under any condition of things there can be more than three of such dimensions as length, breadth, and thickness.'[17] Theosophy postulates endless interpenetrating worlds or planes composed of different grades of energy-substance, with only our own immediate world being within our range of perception. But other planes are not extra 'dimensions'; on the contrary, objects and entities on any plane are extended in three dimensions – no more and no less.[18]

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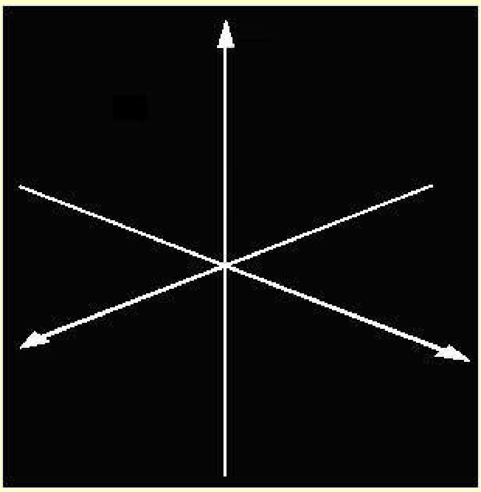
18. One writer (*Sunrise*, Dec 1995/Jan 1996) has claimed that the extra dimensions proposed by string theory are 'foreshadowed' by H.P. Blavatsky's statement in 1888 that 'six is the representation of the *six* dimensions of all bodies: ...' (*The Secret Doctrine*, 2:591). But note how the quote continues: '... the *six* lines which compose their form, namely, the four lines extending to the four cardinal points, North, South, East, and West, and the two lines of height and thickness that answer to the Zenith and the Nadir.' In other words, Blavatsky is simply referring to the ordinary three dimensions of space (length, breadth, and height/thickness). At any point in three-dimensional space we can construct three intersecting lines or axes that are all at right angles to one another; each line extends in two directions, so that there are six directions in all. If there were a fourth dimension of space we would be able to add a fourth line at right angles to *all* the other three.



5. Quantum weirdness – quantum claptrap

The mathematical formalism of quantum theory has proved to be extremely effective, but there is no consensus on what the mathematics actually describes. A common claim is that the quantum world has been proved to be utterly weird, indeterministic, unvisualizable, counterintuitive, and impervious to human logic. It is supposedly governed by absolute chance, and particles allegedly exist as fuzzy 'probability waves' which somehow turn into real particles only when we try to measure them. This popular belief is, however, pure fiction. Many physicists have shown that all experimental results are fully amenable to a rational, commensensical, causal interpretation provided we introduce a subquantum level of reality.

Uncertainty and causality

The famous 'uncertainty principle' formulated by Werner Heisenberg in 1927 says that it is impossible to simultaneously measure with precision both the position and momentum of a particle, or the energy and duration of an energy-releasing event; the uncertainty can never be less than Planck's constant (h). It goes without saying that some measurement uncertainty must exist, since any measurement must involve the exchange of at least one photon of energy which disturbs the system being observed in an unpredictable way. Obviously, the fact that *we* don't know the exact properties of a particle or the exact path it follows does not mean that it doesn't follow a definite trajectory or possess any definite properties unless we are trying to observe it. But this was the interpretation proposed by Danish physicist Niels Bohr, and most physicists in the 1920s followed his lead, giving rise to the prevailing Copenhagen interpretation of quantum physics.

The conventional interpretation assumes that particles are subject to utterly random quantum fluctuations; in other words, the quantum world is believed to be characterized by absolute indeterminism and irreducible lawlessness. David Bohm, on the other hand, took the view that the abandonment of causality had been too hasty:

> it is quite possible that while the quantum theory, and with it the indeterminacy principle, are valid to a very high degree of approximation in a certain domain, they both cease to have relevance in new domains below that in which the current theory is applicable. Thus, the conclusion that there is no deeper level of causally determined motion is just a piece of circular reasoning, since it will follow only if we assume beforehand that no such level exists.[1]

James Wesley argues that the uncertainty principle is logically and scientifically unsound, and empirically false. It applies only in certain restricted measurement situations, and does not represent a limit on the knowledge we can have about the state of a system. He gives six examples of the experimental failure of the uncertainty principle. For example, the momentum and position of an electron in a hydrogen atom are known to a precision six orders of magnitude greater than is permitted by the uncertainty principle.[2] In Wesley's causal or classical quantum theory, the uncertainty principle is superfluous.

Even Heisenberg had to admit that the uncertainty principle did not apply to retrospective measurements. As W.A. Scott Murray says:

> By observing the same electron on two occasions very far apart in time and space, we can determine where that electron was at the time of the first measurement and how fast it was then moving, and we can in principle determine *both* those quantities after the event *to any accuracy we please*. ... [O]ur ability to calculate precisely the earlier position and momentum of an electron on the basis of later knowledge constitutes philosophical proof that the electron's behaviour during the interval was determinate.[3]

According to the Copenhagen interpretation, microphysical particles do not obey causality as individuals, but only on average. But how

can a supposedly lawless quantum realm give rise to the statistical regularities displayed by the collective behaviour of quantum systems? To assume that certain quantum events are completely noncausal just because *we* cannot predict them or identify the causes involved is completely unjustified. No one has ever demonstrated that any event occurred without a cause, and it is therefore reasonable to assume that causality is obeyed throughout infinite nature. H.P. Blavatsky writes: ‘It is impossible to conceive anything without a cause; the attempt to do so makes the mind a blank.’[4] This implies that there must be a great many scientists walking around with blank minds!

Collapsing abstractions

A quantum system is represented mathematically by a wave function, which is derived from Schrödinger’s equation. The wave function can be used to calculate the probability of finding a particle at any particular point in space. When a measurement is made, the particle is of course found in only one place, but if the wave function is assumed to provide a complete description of the state of a quantum system – as it is in the Copenhagen interpretation – it would mean that in between measurements the particle dissolves into a ‘superposition of probability waves’ and is potentially present in many different places at once. Then, when the next measurement is made, this entirely hypothetical ‘wave packet’ is supposed to ‘collapse’ instantaneously, in some random and mysterious manner, into a localized particle again.

The idea that particles can turn into ‘probability waves’, which are no more than abstract mathematical constructs, and that these abstractions can ‘collapse’ into a real particle is yet another instance of physicists succumbing to a mathematical contagion – the inability to distinguish between abstractions and concrete systems.

Moreover, since the measuring device that is supposed to collapse a particle’s wave function is itself made up of subatomic particles, it seems that its own wave function would have to be collapsed by another measuring device (which might be the eye and brain of a human observer), which would in turn need to be collapsed by a further measuring device, and so on, leading to an infinite regress. In fact, the standard interpretation of quantum theory implies that all the macroscopic objects we see around us exist in an objective, unambiguous state only when they are being measured or observed. Erwin Schrödinger devised a famous thought-experiment to expose the absurd implications of this interpretation. A cat is placed in a box containing a radioactive substance, so that there is a 50-50 chance of an atom decaying in one hour. If an atom decays, it triggers the release of a poison gas, which kills the cat. After one hour the cat is supposedly both dead and alive (and everything in between) until someone opens the box and instantly collapses its wave function into a dead or alive cat.

Various solutions to the ‘measurement problem’ associated with wave-function collapse have been proposed. A particularly absurd approach is the many-worlds hypothesis, which claims that the universe splits each time a measurement (or measurement-like interaction) takes place, so that all the possibilities represented by the wave function (e.g. a dead cat and a living cat) exist objectively but in different universes. Our own consciousness, too, is supposed to be constantly splitting into different selves, which inhabit these proliferating, noncommunicating worlds.

Other theorists speculate that it is consciousness that collapses the wave function and thereby creates reality. In this view, a subatomic particle does not assume definite properties when it interacts with a measuring device, but only when the reading of the measuring device is registered in the mind of an observer. According to the most extreme, anthropocentric version of this theory, only selfconscious beings such as ourselves can collapse wave functions. This means that the whole universe must have existed originally as ‘potentia’ in some transcendental realm of quantum probabilities until selfconscious beings evolved and collapsed themselves and the rest of their branch of reality into the material world, and that objects remain in a state of actuality only so long as humans are observing them.[5]

Some mystically-minded writers have welcomed this approach as it seems to reinstate consciousness at the heart of the scientific worldview. It certainly does – but at the expense of reason, logic, and common sense. According to theosophic philosophy, the ultimate reality is consciousness, or rather consciousness-life-substance, existing in infinitely varied degrees of density and in an infinite variety of forms. The physical world can be regarded as the projection or emanation of a *universal* mind, in the sense that it has condensed from ethereal and ultimately ‘spiritual’ grades of energy-substance, guided by patterns laid down by previous cycles of evolution. But to suggest that physical objects (e.g. the moon) don’t exist unless we humans are looking at them is just plain stupid – mystification rather than genuine mysticism. The human mind only exercises a direct and significant influence on physical objects in cases of genuine psychokinesis or ‘mind over matter’.

Causal interpretation

The probabilistic Copenhagen approach was strongly opposed by Albert Einstein, Max Planck, and Erwin Schrödinger. In 1924 Louis de Broglie proposed that the motion of physical particles is guided by ‘pilot waves’. This idea was later further developed by David Bohm, Jean-Pierre Vigier, and a number of others physicists, giving rise to an alternative, more realistic and intelligible interpretation of quantum physics.[6]

The Bohm-Vigier causal or ontological interpretation holds that a particle is a complex structure that is always accompanied by a pilot wave, which guides its motion by exerting a quantum potential force. Particles therefore follow causal trajectories even though we cannot measure their exact motion. For Bohm the quantum potential operates from a deeper level of reality which he calls the ‘implicate order’, associated with the electromagnetic zero-point field. It is sometimes called a ‘subquantum fluid’ or ‘quantum ether’. Vigier sees it as a Dirac-type ether consisting of superfluid states of particle-antiparticle pairs. Bohm postulated that particles are not fundamental, but rather relatively constant forms produced by the incessant convergence and divergence of waves in a ‘superimplicate order’, and that there may be an endless series of such orders, each having both a matter aspect and a consciousness aspect.

One of the classic demonstrations of the supposed weirdness of the quantum realm is the double-slit experiment. The apparatus consists of a light source, a plate with two slits cut into it, and behind it a photographic plate. If both slits are open an interference pattern builds up on the screen even when photons or other quantum particles are assumed to approach the slits one at a time. The Copenhagen interpretation is that a single particle passes in some indefinable sense through both slits simultaneously and somehow interferes with itself; this is attributed to ‘wave-particle duality’, for which it offers no further explanation. In the Bohm-Vigier approach, on the other hand, each particle passes through only one slit whereas the quantum wave passes through both, giving rise to the

interference pattern.

In the Bohm-Vigier model, then, the quantum world exists even when it is not being observed and measured. It rejects the positivist view that something that cannot be measured or known precisely cannot be said to exist. The probabilities calculated from the wave function indicate the chances of a particle being at different positions regardless of whether a measurement is made, whereas in the conventional interpretation they indicate the chances of a particle coming into existence at different positions when a measurement is made. The universe is constantly defining itself through its ceaseless interactions – of which measurement is only a particular instance – and absurd situations such as dead-and-alive cats therefore cannot arise.

James Wesley has criticized the Bohm-Vigier approach for accepting too much of the traditional quantum theory. He argues that the conventional Schrödinger theory is hopelessly inconsistent; the calculated particle flux and density are based purely on theoretical speculation, and Schrödinger made the impossible claim that bound systems are devoid of any motion whatsoever – in other words, the electron in the hydrogen atom can have orbital angular momentum without any orbital motion. Bohm's theory accepts Schrödinger's arbitrary flow lines but says they should be taken seriously and accepted as actual quantum particle trajectories. Wesley says that the equations concerned do not give the correct velocities and yield the correct trajectories only when the time-average approximation is admissible, as it is in the double-slit experiment.[7]

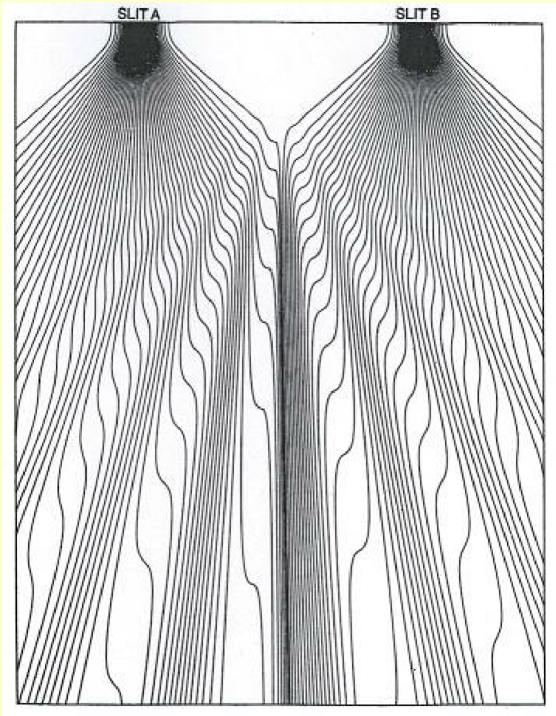


Fig. 5.1 Time-average quantum particle trajectories in the double-split experiment.[8]

Regarding the double-slit experiment, Wesley points out that the assumption that, if the light intensity is very weak, photons approach the slits individually, has never been experimentally verified. He argues that photons are emitted in bursts, and that for every photon or other quantum particle detected, over 100 escape detection. He cites several experiments showing that a flux of widely separated photons exhibits no interference, contradicting the predictions of both the Bohm-Vigier and Copenhagen interpretations.[9] He argues that interference, wave behaviour, and quantum effects can arise only in a system of many coherent particles. He concedes that the underlying cause of the wave behaviour exhibited by quantum particles remains obscure. Indeed, since he rejects the existence of a subquantum ether it is hard to see how he could arrive at a causal explanation of particle motions.

Quantum entanglement

Quantum theory predicts that if a molecule decays into two atoms with opposite spins, or if an atom emits two photons with opposite spins, and the two atoms or photons fly apart in opposite directions, their behaviour will remain correlated, no matter how far apart they are, in a way that cannot be explained in terms of signals travelling between them at or slower than the speed of light. The spin-correlated atoms or photons are described by a single wave function, implying that they are a single system. This means that if a measurement is made to determine the spin of one of the two systems (the result being unpredictable, because the measurement inevitably disturbs the system), a simultaneous measurement on the second system will measure the opposite spin. This phenomenon is called nonlocality or quantum entanglement.[10] Experiments to verify this phenomenon are sometimes called 'EPR experiments', after Einstein, Podolsky, and Rosen, who proposed the original thought-experiment.

The first significant EPR experiments were performed by Alain Aspect and his team in 1982, using polarized photons produced in atomic cascades. Several other tests have been performed since then.[11] It is generally believed that these experiments have confirmed the existence of 'nonlocal' connections. It should be noted, however, that all such experiments to date have loopholes and are therefore inconclusive.[12] Aspect's team, for example, assumed that their photomultipliers detected photons with 100% efficiency (as opposed to a more realistic figure of 0.2%), failed to publish their raw data and had to indulge in highly dubious data manipulation before obtaining the desired result.[13]

If nonlocal connections *are* real, how should they be interpreted? The usual interpretation is that they are an example of instantaneous, noncausal 'action at a distance', and do not involve the transmission of any sort of energy or signal between the 'entangled' systems. An alternative, causal view is that the particles are communicating not absolutely instantaneously but merely faster than light. Vigier proposed that nonlocal interactions are mediated by the quantum potential, carried by superluminal phase waves in the quantum ether.

Some writers have claimed that 'quantum entanglement' shows that 'science' has proved the mystical tenet that everything in the universe is interconnected. This is a gross exaggeration. Quantum theory implies that quantum entanglement only occurs in specific circumstances. It goes without saying that there are ceaseless interactions between all the various systems making up the universe. Moreover, there are good reasons for positing a subquantum ether in which signals and forces can propagate faster than light – but *not* absolutely instantaneously. It does not necessarily follow, however, that the spin behaviour of two photons of common origin must always be precisely correlated. So if some future, foolproof entanglement experiment were to disprove the nonlocal correlations predicted by quantum theory, it would not disprove the possibility of the superluminal transmission of force, energy, or information.

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6. Alternative models and the ether

In modern physics subatomic particles are variously described as zero-dimensional points, one-dimensional strings, two-dimensional spacetime ribbon-tape, wave functions, or packets of probability waves. All of these are mathematical abstractions. Some of the equations associated with these concepts may be useful, but the theories concerned do not provide a realistic model of what particles are and why they have particular properties. Clearly they must be finite, three-dimensional entities, and composed of *something*, i.e. energy-substance of some kind. They must have structure and be capable of deforming (i.e. changing size and shape) otherwise they would be unable to absorb, emit, or exchange energy with other particles. The standard model of particle physics is inadequate because it is no more than a mathematical model. A few examples of alternative models are outlined below.

Eric Lerner has suggested that particles may be vortices in a fluid medium. He points out that plasma – a magnetized fluid – forms particlelike structures (plasmoids) ranging in size from thousands of a millimetre to light-years. As mentioned in section 2, experiments with spin-aligned protons imply that protons are a kind of vortex. Plasmoid vortices interact far more strongly when they are spinning in the same direction, and because vortex behaviour would become evident only in near-collisions, the effects should be more pronounced at higher energies and in more head-on interactions. Experimental results confirm this, whereas the broken-symmetry approach favoured by mainstream physics predicts that the opposite should happen at higher energies. Lerner adds: 'Particles act as if they have a "handedness," and the simplest dynamic process or object that exhibits an inherent orientation is a vortex. Moreover, right- and left-handed vortices annihilate each other, just as particles and antiparticles do.'[1]

The idea of reality being formed out of vortices was put forward by Anaxagoras 2500 years ago, and was championed by Descartes in the 17th century. In the late 19th century, some scientists proposed that atoms might be vortices in an underlying etheric medium, which was also widely invoked to explain the transmission of forces and light waves. In the early 20th century, the ether went out of fashion among mainstream scientists, and was replaced with (curved) empty space containing a variety of 'fields'. It should be noted that the famous Michelson-Morley experiment of 1887 did not disprove the existence of an ether. It failed to detect a variation in the speed of light caused by the earth's motion through a hypothetical *stationary* ether. In 1905 Einstein dismissed the ether as 'superfluous', as light could be understood as consisting of particles (photons) rather than waves propagating through a medium. Later he introduced the notion of a 'gravitational ether', but he reduced it to an empty abstraction by denying it any energetic properties. Later still, he abandoned the term 'ether' altogether.[2] However, numerous individual scientists have continued to develop ether-based models. Such models are already 'unified' in the sense that physical matter and forces are derived from the activity of the underlying etheric medium.

As already mentioned, some physicists speak of a 'quantum ether'. This refers to two things: 1) the zero-point field (ZPF), i.e. fluctuating electromagnetic radiation fields produced by random quantum fluctuations that, according to quantum theory, persist even at a temperature of absolute zero (-273°C); 2) innumerable pairs of short-lived 'virtual' particles (such as electrons and positrons), sometimes called the 'Dirac sea'. Formally, every point of space should contain an infinite amount of zero-point energy. By assuming a minimum wavelength of electromagnetic vibrations, the energy density of the 'quantum vacuum' has been reduced to the still astronomical figure of 10^{108} joules per cubic centimetre.

Although various experimental results are widely interpreted as consistent with the existence of zero-point energy, further work is needed to test the theory and alternative explanations. Some scientists have theorized that mass, inertia, and gravity are all connected with the fluctuating electromagnetic energy of the ZPF. However, the ZPF itself is usually regarded as the product of matter-energy, which supposedly originated in the 'big bang', whereas modern ether theories generally hold that physical matter crystallizes out of or dissolves back into the preexisting ether. At present the only verified all-pervasive electromagnetic energy field is the cosmic microwave background radiation, which is commonly hailed as the afterglow of the big bang, but is also explicable as the temperature of space, or rather of the ether.[3]

Paul LaViolette has developed a theory known as 'subquantum kinetics', which replaces the 19th-century concept of a mechanical, inert ether with that of a continuously transmuting ether.[4] Physical subatomic particles and energy quanta are pictured as wavelike or vortex-like concentration patterns in the ether. A particle's gravitational and electromagnetic fields are said to result from the fluxes of different kinds of etheric particles, or etherons, across their boundaries, and the associated etheron concentration gradients.

LaViolette believes that an etheric subatomic particle might resemble the vorticular structures that theosophists Annie Besant and Charles Leadbeater observed during their clairvoyant examination of atoms from 1895 to 1933. They called these objects 'ultimate physical atoms' (UPAs), which they considered to be the basic unit of physical matter, existing on the seventh and highest ('atomic') subplane of our physical plane; they said that any effort to dissociate a UPA further caused it to disappear from our own plane of reality.[5]

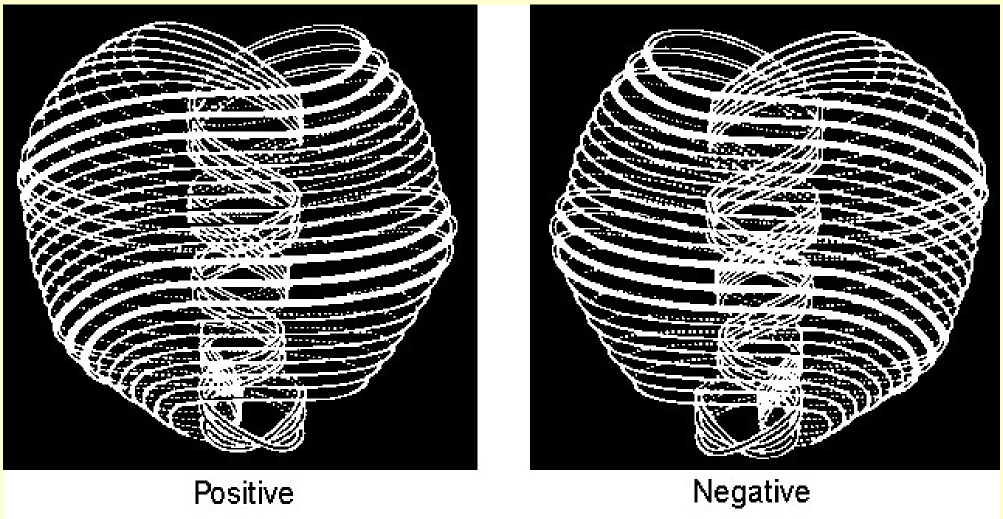

Fig. 6.1 'Ultimate physical atoms' as described by Besant and Leadbeater.

The positive and negative forms of UPAs differ in the direction of their whorls and of the force pouring through them. In the positive UPA, the force is said to pour from the astral plane into the physical plane, while in the negative form it pours from the physical plane through the atom and into the astral plane. LaViolette believes that the ether streams flowing into and out of positive or negative etheric subatomic particles in his own model may look something like this. He writes:

> Vortical structures similar to those drawn by Besant and Leadbeater have been observed at a more macroscopic level in plasma physics experiments. For example, the plasma focus device, a high-current spark discharge device used in fusion experiments, is observed to produce spherical plasma vortices measuring about a half-millimeter across. Each such plasmoid consists of eight or ten electric current plasma filaments twisted into a helical donut-shaped structure that closely resembles the whorl patterns [in fig. 6.1] ...[6]

19th-century scientists were confused about the properties of the ether, because to explain the transmission of light waves it had to behave like a vibrating solid, but to avoid retarding the motion of celestial bodies it had to be a perfect fluid. Harold Aspden's very detailed ether model considers the ether to have the properties of a liquid crystal. It is composed of charged particles (quons), set in a cubic structured array, within a uniform charge continuum of opposite polarity, so that it is electrically neutral overall. His model can explain the value of the fine-structure constant (which links Planck's constant, electron charge, and the speed of light), the proton-electron mass ratio (based on the proposal that protons are formed from virtual muons, which provide the main sea of energy in the ether), and the gravitational constant, among other things. His theory explains gravitation as an electrodynamic phenomenon, allows for the existence of antigravity, and proposes that the induction of ether spin permits the extraction of 'free' (i.e. etheric) energy.[7]

Aspden refers to the following simple experiment pointing to the existence of an ether. A rotor containing a magnet is brought up to a certain speed of rotation, then suddenly brought to a complete stop, and then promptly restarted. Aspden found that the energy required to bring it up to the same speed the second time was only a tenth of that required the first time, but this ceased to be the case if he waited half an hour before restarting the rotor. This suggests that the ether coextensive with the rotor spins with it, but whereas the motor can be stopped within a few seconds, the ether takes much longer to stop spinning.[8]

Paulo and Alexandra Correa, too, have developed a very detailed model of a dynamic ether, known as aetherometry. Their experiments with electroscopes, 'orgone accumulators' (specially designed metal enclosures or Faraday cages), and Tesla coils point to the

existence of both electric and nonelectric forms of etheric energy.[9] They rule out a purely electromagnetic ether, such as the zero-point field. They contend that ether units 'superimpose' to form physical particles, which take the shape of a torus. Pursuing an insight of Wilhelm Reich, they have found evidence that photons do not travel through space: the sun emits electric, etheric radiation which can travel much faster than the speed of light, and photons are transient, vortex-like structures generated from the energy shed by decelerating physical charges (such as electrons). They argue that gravity is essentially an electrodynamic force, and have found experimental evidence of antigravity.[10] Aetherometry proposes that the rotational and translatory movements of planets, stars, and galaxies are the result of spinning, vortical motions of ether on multiple scales.

Demonstrations that energy can be tapped from sources not recognized by official physics will help to revive wider scientific interest in the ether, which is an infinite source of nonpolluting energy. Several scientists take the view that an energetic ether is needed to explain low-energy nuclear reactions ('cold fusion').[11] Many mainstream scientists deny the possibility of room-temperature fusion with table-top reactors simply because conventional theories say fusion requires temperatures of tens of millions of degrees. Indeed, billions upon billions of dollars are being squandered in an effort to create a hot fusion reactor that supposedly imitates the processes powering stars. Aspden argues that the sun cannot possibly be a nuclear fusion reactor because it is ionized and electrostatic repulsion between protons would prevent it compacting sufficiently to produce at its core the extreme temperatures and pressures required for hot fusion.[12]

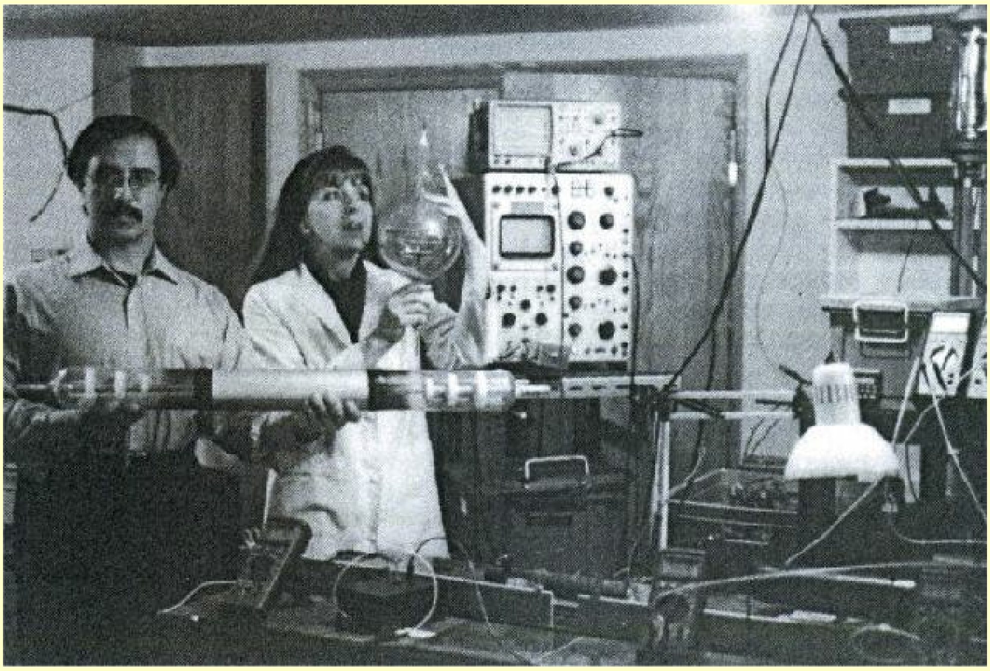

Fig. 6.2 *Top:* Dr Paulo and Alexandra Correa holding PAGD reactors in their laboratory.[13]
Below: PAGD diode in action (www.aetherometry.com).

The Correas have developed three power-generation technologies:
• the patented Pulsed Abnormal Glow Discharge (PAGD) plasma reactor, which produces excess energy by setting up a resonance between accelerated electron plasma and local etheric energy;
• the patented self-sustaining aether motor, which extracts etheric energy from Faraday cage-like enclosures or resonant cavities, living beings, the ground, vacua, and atmospheric antennas;
• the HYBORAC energy converter, which taps the latent heat of a Faraday cage and can supply heat, mechanical work, and electricity around the clock using solar and atmospheric etheric energy.[14]

Ether science is still in its infancy, and it is only natural that there should be a multitude of largely conflicting models. These theories at least show that more rational models are possible. At best, they may identify useful numerical relationships and equations, and propose concepts that approximate to realities in nature. But all models inevitably embody simplifications, idealizations, and abstractions to some extent. The future progress of physics will largely depend on a concerted scientific effort to explore the unseen ether.

A theosophical perspective

From a theosophical standpoint, there can be no ultimate, 'bottom' level of reality. The underlying ether cannot be perfectly continuous,

i.e. absolutely structureless and homogenous, as this is an impossible abstraction; it must consist of particlelike discontinuities that can act together to form waves. Following the principle of analogy, such particles would be concentrations of a deeper, subtler ether, which can be thought of as relatively continuous, but actually consists of even finer particles, which are in turn concentrations of an even subtler ether, and so on, ad infinitum. The 'empty' space separating particles and objects on any particular plane, and through which they appear to move, is not so much *filled with* as *composed of* and *generated by* all the interpenetrating, invisible grades of energy-substances forming higher and lower spheres and planes beyond our range of perception. Space is therefore not absolutely empty, as this would be equivalent to pure nothingness. Rather it is the infinite totality of all the energy-substance, or consciousness-substance, in existence.

What to us are subatomic particles are no doubt, on their own level, just as complex as our own planet and star. For us, an electron can be regarded as an elementary particle, but it obviously has a shape and structure and is therefore divisible. Being a configuration of condensed ether energy, it can be broken apart and its energy can reform as less stable, very short-lived particlelike 'resonances'. What we call an electron is probably not a single, continuously existing entity; it denotes the average behaviour of an entity that is continually reembodying with incredible rapidity. A year for us means a single orbit of the sun, and a 'year' for an electron would be a single orbit of the atomic nucleus; one second for us is therefore equivalent to about 4 million billion electron-years.[15]

Nature is infinite in all directions. There is no smallest finite size, and no largest finite size. Between the two abstract limits of the infinite and infinitesimal, there is an unimaginable diversity of concrete, finite entities and things, of infinitely varied sizes and composed of infinitely varied grades of energy-substance, all of them alive and conscious to some degree. Every entity or system – atoms, planets, stars, galaxies, etc. and the living entities that form them and inhabit them – is composed of smaller entities and forms part of ever larger entities. In addition, any particular entity or system is composed of a spectrum of energy-substances, from relatively physical to relatively spiritual. And every hierarchy of interacting worlds is merely one in an endless series, stretching 'upwards' to increasingly ethereal realms, and 'downwards' to increasingly denser realms.

Apart from the lowest etheric levels, which can be considered as the highest subplanes of our own physical plane, the inner, invisible worlds cannot be probed directly with physical instruments. However, the existence of subtler planes and bodies can be inferred from a wide range of 'anomalous' phenomena.[16] Accurate first-hand knowledge of some of the higher planes forming part of our own system of worlds can only be gained by those who have sufficiently developed their inner occult faculties and powers.[17] The adepts say that they build their philosophy on 'experiment and deduction',[18] but their field of investigation extends far beyond the outer physical shell of nature.

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5. Stephen Phillips argues that there is strong evidence that the results of Besant and Leadbeater's clairvoyant research into atoms were not simply the product of hallucination, fabrication, or coincidence (e.g. their apparent discovery of isotopes five years before official science). But he shows that were certainly mistaken in thinking that they were observing the atoms and molecules known to science. The 'atoms' they saw were made up of a population of 'ultimate physical atoms' (UPAs) that was numerically equal to about 18 times the atomic weight of the chemical element in question.
   To reconcile their findings with modern physics, Phillips speculates that B&L's clairvoyant observations brought about a disturbance that caused two atomic nuclei of the element being observed to collide and fuse, and that each UPA is one of the three hypothetical subquarks forming each of the three hypothetical quarks composing a proton or neutron, with quarks being joined together by hypothetical superstrings. (B&L did not apparently see any electrons.) A UPA is also supposed to be a magnetic monopole, and the 'wall' around the groups of UPAs seen by B&L is said to be the boundary between different domains of the hypothetical Higgs field. No doubt when quarks, superstrings, and Higgs go out of fashion someone will find a way of connecting B&L's UPAs to whatever replaces them!
   (See 'Occult chemistry', Philip S. Harris (ed.), *Theosophical Encyclopedia*, Quezon City, Philippines: Theosophical Publishing House, 2006, pp. 456-61; E. Lester Smith, *Occult Chemistry Re-evaluated*, Wheaton, IL: Theosophical Publishing House, 1982.)
   B&L may well have observed something real, but there are few people nowadays who think there was no self-deception at all involved in their various clairvoyant observations – e.g. their descriptions of the past lives of themselves and their associates, their meetings with mahatmas and initiatory experiences on the astral plane, and their descriptions of the inhabitants of other planets in our solar system. (See 'Leadbeater, Charles Webster', *Theosophical Encyclopedia*, pp. 367-73; Gregory Tiller, *The Elder Brother: A biography of Charles Webster Leadbeater*, London: Routledge & Kegan Paul, 1982.)

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Space, time and relativity

The infinite divisibility of matter

Worlds within worlds

Homepage